FOOD RESPONSIVENESS, PARENTAL FOOD CONTROL AND ANTHROPOMETRIC OUTCOMES AMONG YOUNG AMERICAN INDIAN CHILDREN: CROSS-SECTIONAL AND PROSPECTIVE FINDINGS

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Objective: Assess cross-sectional and prospective associations between food responsiveness and parental food control and anthropometric outcomes among American Indian children.

Design: Parents/caregivers completed psychosocial surveys and trained staff measured children's anthropometry at baseline (kindergarten) and at follow-up (1st grade) as part of a school-based obesity prevention trial (Bright Start).

Setting: On/near the Pine Ridge Indian reservation.

Participants: 422 child (51% female, mean age=5.8 years, 30% overweight/obese) and parent/caregiver (89% mothers) dyads.

Main Outcome Measures: Two independent variables (child's Food Responsiveness and Parental Control scales) and six child anthropometric dependent variables (overweight status, body mass index z-score, % body fat, waist circumference, triceps skinfold, subscapular skinfold). Linear regression analyses, stratified by sex and adjusted for age and treatment condition.

Results: Baseline Food Responsiveness scale scores were positively associated with all six baseline anthropometric outcomes among boys (P's all <.01), but not girls. Parental Control scale scores were not significantly associated with outcomes and no prospective associations were statistically significant.

Conclusions: Responsiveness to food may be associated with excess adiposity in young American Indian boys, however, the effects are not detectable over time. Obesity prevention programs for American Indian children may benefit by addressing eating without hunger among boys. (*Ethn Dis.* 2013;23[2]: 136–142)

Key Words: Food Responsiveness, Parental Food Control, BMI, Anthropometry, Obesity, American Indian, Children

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INTRODUCTION

Although several decades ago problems with being underweight and malnourished were major issues for American Indian youth,[1,2] today obesity is highly prevalent. In the 1990's, obesity rates among American Indian children and adolescents exceeded rates of children with other racial/ethnic backgrounds in the general US population.[2–5] Data from 2001–2007 indicate that the odds of obesity among American Indian youth nationally is about 2–3 times greater than other children their age.[6,7]

The development of obesity is complex, affected by genetic, environmental and personal influences. In obesity prevention research, the goal is to identify and change key malleable influences. In this regard, environmental changes are important, particularly for young children who do not typically have much control over the foods and activity resources available to them in their daily lives. Parents/caregivers are the primary providers of foods and beverages during the early school-age years[8] and they greatly influence their children's eating patterns.

In the last decade, particular attention has focused on the influence of parental feeding practices on children's weight status and other obesity indicators. Birch and colleagues have shown that parental restriction of children's eating (parent restricts child's access to foods), particularly with highly palatable

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foods, is positively associated with children's weight.[8–10] Parental food restriction is a form of parental food control and scales developed to measure these concepts often include items that measure parental attempts to limit their children's access and intake of particular foods. This early work hypothesized that too much parental food control interferes with children's ability to regulate their own intake.[8] However, much of the research has focused on homogenous samples and results have been inconclusive.[11]

A few studies have examined parental feeding practices, including parental food restriction and parental control, among lower income and racially-diverse youth. Taveras et al identified greater use of restrictive feeding practices among Black and Hispanic mothers compared to White mothers as a risk factor for obesity.[12] Powers et al found a positive association between maternal food control and children's body mass index (BMI) z-score, however, this finding was limited to obese mothers.[13] In contrast, feeding practices were unrelated to a child's sex or weight in a study with children from the United Kingdom.[14] A study of African American girls and boys found significant cross-sectional associations between parental food restriction and total fat mass,[15] however, these associations did not hold when examined over time. These studies indicate that food restriction or some form of parental food control appears to be related to children's weight status cross-sectionally. Few prospective studies have investigated these relationships, although a recent study showed that parental food control may be protective of weight gain among young children

over time.[16] It is clear that more work is needed in this area to understand whether parental control of children's food intake, in one form or another, is either detrimental or protective of subsequent weight gain, particularly in youth at high-risk for obesity.

A child's personal characteristics may also affect weight. For example, one's susceptibility to the hedonistic qualities of food and lack of internal cues for hunger,[17,18] termed food responsiveness by Wardle et al,[19,20] may increase the likelihood of weight gain. Children who show susceptibility to foods in environments such as homes, schools and/or communities that are abundant with unhealthful foods may be particularly affected.[21] Being overly influenced by food without reference to satiety can be hazardous, particularly in an obesity-promoting environment.[21] Several studies have investigated food responsiveness among children and its significant and positive relation to overweight and obesity.[18,22,23] Less is known about children's responsiveness to food among youth at high-risk for obesity.

Our study assessed both cross-sectional and prospective associations between scores on Food Responsiveness and Parental Control scales with six anthropometric outcomes (child weight status, BMI-z score, triceps and subscapular skinfolds, waist circumference, and % body fat) among high-risk

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American Indian children to assess these two important parent and child characteristics in relation to weight. Our study adds to the literature regarding parental feeding practices and associations with overweight and obesity by evaluating these associations with a sample of low-income American Indian youth who are at high-risk for obesity. Our study also assesses associations with adiposity indicators. Furthermore, study findings may identify specific areas of focus for obesity prevention interventions with American Indian families.

METHODS

Procedures and Participants

Data for the present study came from the Bright Start study, a group-randomized controlled trial (GRT) for the prevention of childhood obesity. The main aim of the Bright Start study was to develop and test the efficacy of a school environmental intervention to reduce excessive weight gain among American Indian children. The Bright Start study included 14 schools with 7 randomized to the intervention condition and 7 randomized to the control condition using two cohorts of schools.[24]

Of the 472 kindergarten children on the records of the 14 schools, we obtained consent for 99% of the children from parents or caregivers (parent) and 97% of those consenting agreed to participate in the study. A total of 454 children (96% of those eligible) had baseline measurements (kindergarten; 2005/2006). At these measurement points, both children and parents had their height and weight measured by trained research staff and parents completed a psychosocial survey where they reported on their own behavior as well as their child's. Parents and children received a $25 gift card at each data collection. Of these study children, 422 (93%) had a parent who completed relevant parental feeding practice items on the survey and participated in final follow-up data collection (end of 1st grade; 2007/2008) and are included

in the present analysis. All study procedures were approved by the University of Minnesota's Institutional Review Board (IRB) and the Oglala Lakota Tribal and Aberdeen Area IRBs.

Measures

Child and Parent Anthropometry

Children's and parents' anthropometry was measured by trained staff. Height was measured to the nearest millimeter using a portable stadiometer (Perspective Enterprises, Portage, Mich) and weight and body composition (% fat) were measured using Tanita scales (Model TBF 300A). Children's age- and sex-adjusted BMI percentile scores were calculated based on the Centers for Disease Control and Prevention (CDC) growth reference[25] so that underweight = BMI≤5th percentile, normal weight = BMI between 5th and 84th percentile, overweight/obese = BMI≥85th percentile. Children's waist circumference was measured to the nearest millimeter and triceps and subscapular skinfolds were measured to the nearest half millimeter following recommended protocols.[26] Consistent with CDC recommendations, parent overweight/obese status was calculated as BMI>25, BMI values between 18.5 and 25 were considered normal weight, and those with a BMI less than 18.5 were considered underweight.[27]

Parent Survey

The parent survey included several validated subscales from the Children's Eating Behaviour Questionnaire[19,20] and the Parental Feeding Style Questionnaire,[28] however, only a limited number of scales were included to reduce participant burden. The Food Responsiveness Scale[19] included five items and measured parental perceptions of children's responsiveness to food cues and external eating. The scale was designed to detect maladaptive levels of appetite and was validated against behavioral measures of eating.[20] In addition, significant and inverse

correlations were found between this scale and a scale measuring slowness in eating[19] indicating that children who are food responsive are more likely to eat at a faster rate. An example item is "My child's always asking for food." Response options were never (0), seldom (1), sometimes (2), often (3) and always (4). Test-retest reliability in the validation sample was r=.83.[19] The scale showed good internal consistency reliability in the development (α=.83)[19] and our study samples (α=.79).

The Parental Control Scale[28] included 10 items and measured parental restriction and pressure to eat to control a child's eating. An example item is "I decide when it is time for my child to have a snack." Response options were I never do (1), I rarely do (2), I sometimes do (3), I often do (4), I always do (5). Cronbach's α was .81 and test-retest reliability was r=.83 in the validation sample.[28] In our study sample, the scores ranged from 1 to 5 and reliability was α=.64.

Statistics

Owing to sex differences in the literature regarding both feeding practices and anthropometry, all models were stratified by child sex. Linear modeling (SAS Proc Mixed) was used to compare Food Responsiveness Scale and Parental Control Scale scores for the six anthropometric outcomes (child overweight/obese status, BMI-z score, triceps and subscapular skinfolds, waist circumference, and % body fat). Separate models were constructed for each scale score and outcome and models tested associations both cross-sectionally (all variables at baseline) and prospectively (Food Responsiveness and Parent Control Scale scores at baseline and anthropometric outcomes at follow-up). All models were adjusted for baseline child age, treatment condition, and school as a random effect (to account for clustering in the GRT). All prospective models also adjusted for baseline values of each outcome. All analyses were completed using SAS 9.2 (SAS Institute, Cary, NC, USA).

RESULTS

Participant Characteristics

As shown in Table 1, 49% of children were female and on average children were approximately 6 years of age. At baseline, 29% of children were overweight/obese (BMI≥85th percentile). Most of the parents were female and on average were approximately 36 years of age (min=19.2, max=74.0). At baseline, 86% of parents were overweight/obese, 14% were normal weight; none were underweight.

Weight Status Comparisons

Compared to the estimates of the general population of 2–5 year olds in the United States that are most similar in timeframe to our study timeline (2007–2008),[29] our study boys and girls were more likely to be overweight/obese than their counterparts (see Figure 1).

Compared to the 68% obesity prevalence rate for adults (age ≥20) in the United States in 2007–2008,[30] parents involved in the Bright Start study (mean age 36 years) were much more likely to be overweight/obese (86%). Differences were slightly more dramatic when comparisons are limited to women aged 20–39 years (US =59.5% vs Bright Start=86%) and women aged 40–59 years (US=66.3% vs Bright Start=84%). These findings show the very high prevalence of overweight/obesity among the American Indian Bright Start sample of children and parents.

As shown in Table 1, girls had significantly higher baseline subscapular and triceps skinfolds than boys while boys had significantly higher BMI z-scores and % body fat than girls. No significant sex differences were noted in BMI or waist circumference. Parent-reported Food Responsiveness scores and Parental Control scores did not significantly differ by child sex (nor parent weight status; data not shown).

Food Responsiveness and Parental Control Score Comparisons

Mean Food Responsiveness scores of 4–5 year-old children in a validation sample of the CEBQ[20] were 2.2 (SD=.74) and 2.3 (SD=.61), respectively. Normal weight boys and girls in the Bright Start sample had mean FR scores that were similar to the validation sample scores (mean 2.1 [SD=.58] and mean=2.3 [SD=.80], respectively). However, underweight and overweight boys and girls in Bright Start had elevated FR scores (mean=2.6 [SD= 1.0] for underweight boys, mean=2.5 [SD=.94] for overweight/obese boys, mean=2.6 [SD=.74] for underweight girls, and mean = 2.4 [SD=.79] for overweight/obese girls).

In comparing Parental Control scores between Wardle's sample of 3–5 year old twins [28] (mean=4.0, SD=.5) and parents of children who participated in Bright Start, Bright Start parents had lower scores (mean = 3.3 (SD=.47; Table 1).

As shown in Table 2, boys' baseline Food Responsiveness scale scores were significantly and positively associated with all six baseline anthropometric outcomes while no significant associations were found for girls. Baseline Parental Control scale scores were not significantly associated with baseline anthropometric outcomes for either sex. Furthermore, prospective associations between both Food Responsiveness scale scores and Parental Control scale scores with all anthropometric outcomes were nonsignificant for both boys and girls (see Table 3). The pattern of findings did not differ when parental BMI was included in the models.

DISCUSSION

Our study assessed both cross-sectional and prospective associations between Food Responsiveness scale scores and Parental Control scale scores with

Table 1. Descriptive baseline characteristics of children and parents and sex differences in anthropometry and feeding-related scale scores

Characteristic	Children			Parents		
	Total N=422	Boys n=217	Girls n=205	Total N=422	Of boys n=217	Of girls n=205
Sex, % female	49	NA	NA	89	86	92
Relationship to child, %						
Mother	NA	NA	NA	67.9	67.6	68.3
Grandmother	NA	NA	NA	15.4	13.4	17.6
Father	NA	NA	NA	8.7	11.1	6.4
Other	NA	NA	NA	8.0	7.9	7.7
Age, years, mean (SD)	5.8 (.5)	5.8 (.5)	5.8 (.5)	35.7 (10.8)	35.2 (9.7)	36.2 (11.8)
Marital status, %						
Single/never married	NA	NA	NA	30	28	32
Married	NA	NA	NA	29	29	29
Not married, living with significant other	NA	NA	NA	21	21	21
Separated	NA	NA	NA	7	8	5
Divorced	NA	NA	NA	10	11	8
Widowed	NA	NA	NA	3	3	5
Weight status[a], %, baseline						
Underweight	4	4	5	0	0	0
Average weight	66	62	70	14	14	14
Overweight /obese	29	34	25	86	86	86
BMI, mean (SD)	16.6 (2.87)	16.9 (2.89)	16.4 (2.84)	32.4 (7.3)	32.2 (6.8)	32.7 (7.9)
BMI z-score, mean, (SD)	.49 (1.18)	.60[b] (1.21)	.37[b] (1.13)	NA	NA	NA
Subscapular skinfold, mm, mean (SD)	6.99 (3.70)	6.64[b] (3.42)	7.36[b] (3.97)	NA	NA	NA
Triceps skinfold, mm, mean (SD)	10.49 (4.40)	9.95[c] (4.37)	11.06[c] (4.37)	NA	NA	NA
Waist circumference, cm, mean (SD)	57.97 (7.24)	58.44 (7.40)	57.46 (7.06)	NA	NA	NA
Percent body fat, mean (SD)	17.43 (7.62)	19.27[d] (6.39)	15.47[d] (8.32)	NA	NA	NA
Food Responsiveness Scores, mean (SD)	2.30 (.78)	2.27 (.77)	2.33 (.80)	NA	NA	NA
Parental Control Scores, mean (SD)	NA	NA	NA	3.33 (.47)	3.34 (.48)	3.32 (.47)

[a] Underweight: BMI<5th percentile; average weight: BMI is 5th–85th percentile; overweight/obese: BMI≥85th percentile.
[b] P<.05 for sex difference.
[c] P<.01 for sex difference.
[d] P<.001 for sex difference.
NA, not applicable.

six adiposity indicators among American Indian children.

Our findings indicated that underweight and overweight children participating in the Bright Start study had higher Food Responsiveness scale scores than their same-age counterparts, indicating that they may be eating at fast rates and ingesting a high number of calories.[20] Eating fast and consuming excess calories has been shown to be associated with overweight status.[31] Our findings of high Food Responsiveness scale scores among underweight American Indian youth contrast the findings of Webber and Wardle[18] who showed a significant and positive linear trend for Food Responsiveness scale scores by five weight status categories, including underweight, lower healthy weight, higher healthy weight, overweight and obesity. Fears of an inadequate food supply and the belief that it is necessary to eat when food is available may be reflected in the underweight children's response to food.

Parental Control scale scores were lower among parents in the Bright Start study compared to parents in the scale development sample,[28] indicating that parents involved in the Bright Start study were less likely to report restricting their children's intake than parents in the validation sample. There could be several reasons for this difference. One is that the parents involved in the Bright Start
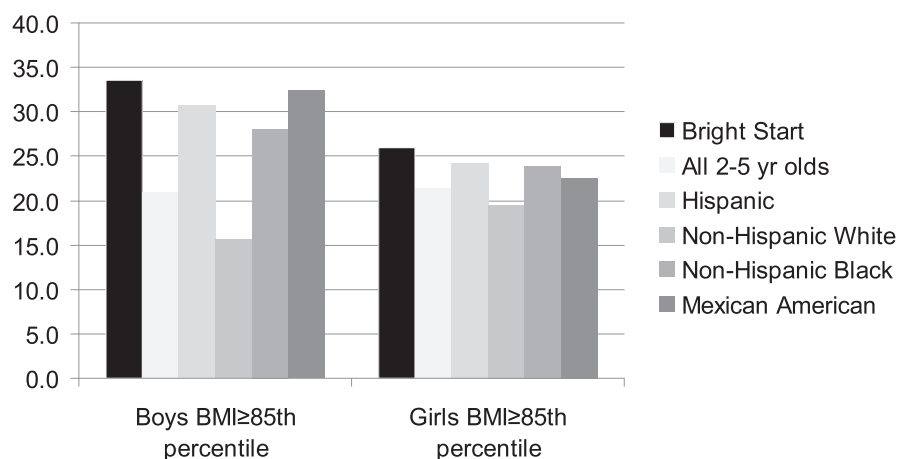
Fig 1. Comparison of prevalence of child overweight status of Bright Start sample to US national data[29] by race/ethnicity

Our findings indicated that underweight and overweight children participating in the Bright Start study had higher Food Responsiveness scale scores than their same-age counterparts, indicating that they may be eating at fast rates and ingesting a high number of calories.[20]

study had relatively lower education levels than the parents in the validation sample and previous research has shown that more educated parents are likely to try to influence their children's eating patterns.[32] However, lack of parental control of children's eating is not surprising in our sample as 40% of parents in the Bright Start study reported experiencing food insecurity;[33] hence, parents may have been more likely to encourage children's eating than to control or restrict it. The tendency for children to eat rapidly and to over-consume calories and parents' style of not influencing what their children eat may be an unhealthful combination in light of the high prevalence of obesity. A

clear assessment of food availability is needed to determine the impact of eating rapidly, excess intake of calories and lack of parental food control is warranted. Moreover, since parental styles of restricting what their children eat is often positively associated with increased weight status, at least cross-sectionally, perhaps the best focus would be to avoid addressing parental food control but directly addressing children's self-regulation of food intake by teaching children how to recognize their satiety cues.

Our cross-sectional findings indicated significant and positive associations between scores on food responsiveness and all anthropometric outcomes among boys, but not girls. However, our

prospective findings were not significant. Thus, boys' responsiveness to food may be positively associated with excess adiposity as they enter elementary school, but effects may not persist over time.

From another perspective, our prospective findings of negative associations between Parental Control scores and five of the six anthropometric indicators among girls (although nonsignificant) are similar to the prospective findings of young children in recent studies[16] and warrant more research. Our research and the prospective research of others[15] challenges the relatively predominant view in the literature that parental food control leads to increased weight gain among young children over time.

Table 2. Cross-sectional associations[a] between food responsiveness, parental control and child anthropometric indicators at baseline (*N*=422), coefficient (SE)

Child Feeding Scales	Overweight Status	BMI-z	Subscapular Skinfold	Tricep Skinfold	Waist Circumference	% Body Fat
Boys						
Food Responsiveness Scale Scores[b]	.14 (.04)[e]	.33 (.11)[d]	1.33 (.29)[e]	1.33 (.38)[e]	3.11 (.63)[e]	2.66 (.55)[e]
Parental Control Scale Scores[c]	.11 (.07)	.22 (.17)	.30 (.49)	1.14 (.62)	.97 (1.05)	1.43 (.92)
Girls						
Food Responsiveness Scale Score[b]	.03 (.04)	.00 (.10)	.37 (.35)	.29 (.39)	.39 (.62)	.04 (.73)
Parental Control Scale Scores[c]	.08 (.06)	.27 (.17)	.30 (.60)	.35 (.67)	.99 (1.06)	.79 (1.26)

[a] Analyses adjusted for child age, treatment condition and the random effect of school.
[b] Scale score range is 0–4.
[c] Scale score range is 1–5.
[d] $P<.01$.
[e] $P<.001$.

Table 3. Prospective associations[a] between food responsiveness, parental control and child anthropometric indicators at follow-up (*N*=422), coefficient (SE)

Child Feeding Scales	Overweight Status	BMI-z	Subscapular Skinfold	Tricep Skinfold	Waist Circumference	% Body Fat
Boys						
Food Responsiveness Scale Scores[b]	.02 (.04)	−.09 (.07)	−.37 (.31)	−.36 (.36)	−.92 (.51)	−.33 (.44)
Parental Control Scale Scores[c]	−.03 (.06)	.09 (.12)	.49 (.47)	−.17 (.56)	.66 (.77)	.16 (.67)
Girls						
Food Responsiveness Scale Score[b]	.05 (.03)	.08 (.05)	.22 (.29)	.31 (.31)	−.36 (.50)	.07 (.35)
Parental Control Scale Scores[c]	−.08 (.05)	−.15 (.08)	−.69 (.47)	−.67 (.52)	.60 (.84)	−.63 (.78)

[a] Analyses adjusted for baseline values, child age, treatment condition and the random effect of school.
[b] Scale score range is 0–4.
[c] Scale score range is 1–5.

As shown in other samples of American Indian youth and adults, children and parents participating in Bright Start are more likely to be overweight or obese compared to their same age counterparts.[30,34] Thus, our study sample is at high risk for obesity-related diseases such as cardiovascular disease and type 2 diabetes. These data indicate that, although there have been several large scale efforts,[35] targeted, culturally-appropriate, obesity prevention programming for both children and adults in American Indian communities are needed.

Several study limitations deserve mention. The self-reported parental data regarding control over their child's eating and their children's food responsiveness may be biased; however, the face validity of our findings among Bright Start participants compared to other samples is supported anecdotally by cultural norms. Moreover, our relatively low internal consistency reliability of the Parental Control scale indicates that the feeding concepts assessed with this scale may not relate to one another in our American Indian sample in the same way as the scale development sample. This issue could have also influenced our inability to see significant associations with weight and other adiposity outcomes. In addition, we made some assumptions regarding the concepts of parental feeding control and parental food restriction from the literature, with Parental Control scale scores reflecting overall parental control of

when a child is allowed to eat (and who makes the decision for him/her to eat) while literature regarding food restriction is associated with limiting access to favorite foods. Differences in scale scores between the Bright Start sample and the comparative samples may have been affected by the older age of the children in the Bright Start sample since parental feeding practices and children's responses to foods may vary by age. However, these data are the only available data for comparative purposes.

Culturally appropriate, obesity prevention programming for American Indian children, particularly family-based programs, is needed. Based on our findings, a better understanding of children's high food responsiveness and low parental control over children's eating is warranted, particularly over an extensive time period in order to assess the long-term implications of parental feeding practices and childhood obesity.

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